



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
Office of Air Quality Planning and Standards
Research Triangle Park, North Carolina 27711

81 OCT 1983

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IV-C-121

Mr. Lawrence W. Lindquist
Manager
ASARCO Incorporated
Post Office Box 1677
Tacoma, Washington 98401

Dear Mr. Lindquist:

This responds to your October 21, 1983, letter to Mr. Robert Ajax and your October 24, 1983, telephone call to me in which you requested a breakdown by source of EPA's revised arsenic emission estimates for the ASARCO-Tacoma smelter and information on the bases and methods used in calculating these estimates.

Enclosed (enclosure 1) is a copy of a letter from me to Mr. George Schewe of PEDCO Environmental, dated October 28, 1983, which confirms the information provided to you during our October 24 telephone conversation, on EPA's estimates for fugitive arsenic emissions from converters and other low-level sources at the ASARCO-Tacoma smelter.

As I indicated to you on the phone, estimates for contributing sources to the main stack remained unchanged, except for the contribution from the reverberatory furnace and arsenic plant. Estimates for the reverberatory furnace and arsenic plant were revised based on preliminary results for the arsenic emission tests conducted at the Tacoma smelter this past September. A summary of these results is enclosed (enclosure 2). Based on these results, the arsenic emission estimate for the reverberatory furnace contribution was revised from 90 tons/year to about 49 tons/year and the estimate for the arsenic plant contribution was revised from 69 tons/year to 1.4 tons/year.

If you have any further questions regarding these estimates, please call me at (919)541-5601.

Sincerely yours,

Alfred E. Vervaert

Alfred E. Vervaert
Industrial Studies Branch
Emission Standards and
Engineering Division

cc: Robert Ajax, SDB (w/o enclosures)
Jack Farmer, OD (w/o enclosures)
Clark Gaulding, EPA/Region X (w/enclosures)
Arthur Dammkoehler, PSAPCA (w/enclosures)

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ENCLOSURE 1

Mr. George Schewe
PEDCo Environmental, Inc.
11499 Chester Road
Cincinnati, Ohio 45246

Dear George:

On August 30, 1983, I sent to Mr. Charlie Zimmer a letter which presented estimates developed by the Emission Standards and Engineering Division (ESED) of low-level arsenic emissions from sources at the ASARCO Tacoma smelter. As I have previously stated, these estimates are based on data which are in the docket for the proposed NESHAP for high-arsenic primary copper smelters and are summarized in the background information document (BID) (EPA-450/3-83-009a) as well as new data obtained during a plant visit to the smelter from June 21 to June 23, 1983. The methodology used by ESED to estimate the low-level arsenic emission values is described in the following paragraphs.

Multihearth Roasters

Emissions from the discharge of calcines from the roasters to the larry cars are captured by a local ventilation system and vented to the roaster baghouse. The arsenic emission rate was estimated based on actual emission measurements conducted by ESED which indicated that potentially 0.03 percent of the arsenic contained in the calcine is discharged as a low-level emission (BID, p. 2-29 and 2-30). Applying this emission factor to the 1982 annual average hourly arsenic throughput rate for the discharge of calcines at ASARCO-Tacoma (2,029 lb/h), which was provided by ASARCO (BID, p. 2-23), an uncontrolled emission rate of 0.6 lb/h was computed. Crediting the ventilation system applied with a capture efficiency of 90 percent based on EPA observations at the smelter (BID, p. 3-61), we estimated a low-level arsenic emission rate for roaster calcine discharge at the smelter of 0.06 pounds per hour (10 percent of 0.6 lb/h).

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Reverberatory Furnace

Local ventilation hoods are placed over the locations on the reverberatory furnace where calcine charging, matte tapping, slag tapping, and converter slag return operations are conducted. During our June 1983 plant visit, each of these operations was observed. Based on these observations, the capture efficiency values reported in the BID were either confirmed or new values assigned. The following capture efficiencies were used to estimate low-level arsenic emissions associated with the reverberatory smelting furnaces.

calcine charging	50%
matte tapping	90%
slag tapping	50%
converter slag return	0%

Emissions from calcine charging were estimated by assuming that the annual average hourly calcine charging rate is equivalent to the 2,029 lb/h rate provided by ASARCO for calcine discharge, and that the emission factor developed for calcine discharge, 0.03 percent of the arsenic contained in the calcine, also applies to calcine charging. The resulting potential emission rate is 0.6 lb/h. Multiplying this value by 50 percent, the quantity of emissions estimated not to be captured by the local ventilation systems currently in-place, the resultant low-level arsenic emission rate for calcine charging is 0.3 lb/h. Please note that the contribution to the main stack arsenic emissions associated with the control of captured calcine charging emissions is negligible, adding less than 0.01 lb/h to the total main stack arsenic emission rate.

The emissions estimate for furnace matte tapping operations is based on emission measurements conducted by ESED at the ASARCO-Tacoma smelter which indicated that potentially 2.5 percent of the arsenic in the matte is discharged to the atmosphere as a fugitive emission (BID, p. 231 and 2-32). Applying this emission factor to the matte arsenic content (327 lb/h) presented in ASARCO's 1982 arsenic material balance (BID, p. 2-23), and multiplying the calculated potential emission rate by 10 percent, which reflects 90 percent capture estimated to be achieved by the local ventilation system currently in place, a low-level arsenic emission rate of 0.8 lb/h was calculated for matte tapping.

To estimate emissions from slag tapping, an emission factor obtained by averaging the ESED developed emission factor of 0.12 percent of the arsenic in the slag (BID, p. 2-31 and 2-33) and the Puget Sound Air Pollution Control Agency (PSAPCA) developed factor of 0.31 percent (Enclosure 1, Table IIIB) was used. Both emission factors are based on actual measurements conducted at the ASARCO-Tacoma smelter. Applying the resultant emission factor of 0.22 percent of the arsenic in the slag to the arsenic mass flow presented for slag tapping in ASARCO's 1982 material balance (463 lb/h of arsenic in the slag tapped) (BID, p. 2-23), a potential

emission rate of 1 lb/h was calculated. Multiplying this value by 50 percent, the quantity of emissions estimated not to be captured, a low level emission rate of 0.5 lb/h for slag tapping was estimated. It should be noted that although this emission estimate has been revised since my August 25, 1983 letter, the new emission estimate does not significantly change the total main stack arsenic emission rate (using the new emission factor the increase in main stack emissions is only 0.02 lb/hr).

Emissions from converter slag return were based on ESED emission measurements conducted at the ASARCO-Tacoma smelter, which showed that 0.03 percent of the arsenic contained in the converter slag is discharged to the atmosphere (BID, 2-34 and 2-35) and ASARCO's 1982 material balance which indicates that 102 pounds of arsenic are returned to the furnace in the converter slag per hour (BID, p. 2-23). Because the hood over the converter slag return port was judged to be essentially ineffective at capturing emissions during our June 1983 inspection, no credit for control was given. The resultant low-level arsenic emission rate calculated for converter slag return is 0.03 lb/h (0.03 percent of 102 lb/h).

During our June 1983 visit to the ASARCO Tacoma smelter, we observed significant visible emissions from leaks in the reverberatory furnace roof. The emission points included leaks around the caps covering the pig iron charging ports and leaks around the cover over a roof opening used for measuring the furnace bath depth. Based on our observations, and considering the large amount of arsenic reported by ASARCO to be in the reverberatory furnace offgases (1,341 lb/h, BID p. 2-23), we believe that the furnace roof leaks should be added to the list of low-level arsenic emission sources. Unfortunately, no measured data are available which quantify the amount of gases leaking from the furnace. To represent the contribution of the furnace roof leaks to low-level arsenic emissions, it was assumed that 0.1 percent of the process offgases leak from the furnace. Multiplying 1,341 lb/h by 0.1 percent, the low-level arsenic emission rate calculated for furnace roof leaks is 1.3 lb/h.

Converters

Based on observations of the No. 1, No. 2, and No. 4 converters in operation during several of our visits to the smelter, we have concluded that the primary hood on the No. 4 converter is substantially more effective at preventing fugitive emissions during blowing than the primary hoods on either the No. 1 or No. 2 converters. Therefore, different emission factors were provided for the No. 4 versus the No. 1 and No. 2 converters. As a result, the hourly arsenic emission rate for the converters will depend on the combination of converters in operation at a particular time.

As you know, based on our recent telephone conversations, we have adjusted the emission factor for the No. 1 and No. 2 converters downward to reflect our present judgment that primary hoods on the No. 1 and No. 2 converters at ASARCO-Tacoma are better in preventing leaks than those

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typically found at other U.S. smelters and those operated at the ASARCO-El Paso smelter when the converter emission measurements were conducted.

The emission factor for the No. 4 converter of 0.1 pound of arsenic emitted per ton of blister copper produced (lb/ton) was obtained by averaging the three values presented in Table 5-12 of PEDCO's July 1983 draft report entitled "Evaluation of an Air Curtain Hooding System for a Primary Copper Converter at ASARCO, Inc. Tacoma, Washington." The emission factor provided for the No. 1 and No. 2 converters of 3 lb/ton was calculated based on information on the operation of the converters and ESED's emission factor developed from emission tests conducted on the converter building evacuation system at ASARCO's El Paso, Texas, smelter (BID, P.2-37), which indicated that the potential of quantity low-level arsenic emissions discharged during converted operations is equal to 15 percent of the arsenic contained in the process primary offgas streams. We applied half this emission factor to the No. 1 and No. 2 converters. To determine the arsenic content of the process offgases during one complete converter cycle, we used operating data presented in Table 2 of an AIME paper entitled "A Survey of Worldwide Copper Converter Practices" (see Enclosure 2). During a cycle, 180 tons of matte are charged to the converter, and the arsenic content of the matte is typically 0.7 percent. Therefore, 2,520 lb of arsenic is charged to the converter per cycle. Based on ASARCO's arsenic material balance around the converters (BID, p. 2-23), 63 percent of the arsenic is emitted in the process offgases. Using this factor, the arsenic content of the process offgases during one complete converter cycle was calculated to be 1,588 lb. Multiplying this value by the 7.5 percent emission factor, a low-level arsenic emission rate of 119 lb per cycle was estimated. Each converter produces 90 tons of blister copper per cycle (Table 2, Enclosure 2). Therefore, the emission factor for the No. 1 and No. 2 converters was determined to be 1.3 lb/ton.

Visible emissions from leaks in the converter balloon flue were observed during our June 1983 visit to the smelter and added to our list of low-level emission sources. To represent the contribution of the balloon flue leaks to low-level arsenic emissions, it was assumed that 0.1 percent of the converter process offgases leak from the flue. Applying this emission factor to the 207 lb/h value for arsenic in the converter process offgases shown in the ASARCO material balance (BID, p. 23) by 0.1 percent, a low-level arsenic emission rate of 0.2 lb/h was estimated.

Anode Furnaces

The low-level arsenic emission rate of 0.2 lb/h for anode furnace operations was based on the ASARCO 1982 arsenic material balance (BID p. 2-23) and visual observations. The material balance indicates that anode furnace operations generate about one pound of arsenic per hour. Visual observations at the smelter indicate that a substantial portion of the process gases generated are discharged into the building as a fugitive emission. For the purpose of developing an emission factor for anode

furnace operations, it was assumed that 20 percent of the process gases produced were discharged as a fugitive emission. Thus, low-level arsenic emissions for anode furnaces were estimated at 0.2 lb/hr (20 percent of 1 lb/hr).

Arsenic Plant

Low-level arsenic emission sources identified in the arsenic plant include the pulling of the arsenic kitchens, the transfer and loading of Godfrey roaster calcines, and a variety of raw material and product handling operations. Arsenic emissions from kitchen pulling were calculated using an emission factor developed by PSAPCA (pages 2-40 and 2-41 of the BID), which estimates that 0.5 percent of the arsenic processed through the arsenic plant is potentially lost during kitchen pulling operations, and an estimate of the capture efficiency achieved by the local ventilation system currently applied. The kitchen pulling operation is ventilated by movable hoods which vent to a baghouse. Based on observations of kitchen pulling operations during our June plant visit, it is our judgment that the hoods are approximately 95 percent efficient in capturing dust emissions generated during kitchen pulling. Applying the 0.5 percent emission factor for potential emissions to the arsenic plant arsenic throughput rate of 2,828 lb/hr provided in ASARCO's 1982 material balance, (BID p.2-23), and assuming that only 5 percent of the potential emissions escape capture, the low-level arsenic emission rate due to kitchen pulling is calculated to be 0.7 lb/h.

Two types of Godfrey roaster calcines are produced depending on the source of high-arsenic flue dust processed. Flue dust collected from the reverberatory furnace and multihearth roasters produce a calcine which contains relatively high copper values and is thus recycled. Flue dust from the converter operations, "white dust", produces a calcine with high lead content, which is shipped by rail to ASARCO's East Helena, Montana, lead smelter for lead recovery. The low-level arsenic emission estimate for the copper-rich calcine is presented in a subsequent section on "Material Handling," while the emission estimate for "white dust" calcine transfer and handling is presented here along with estimates for other material handling operations within the arsenic plant complex. In all cases, potential arsenic emissions were estimated at 0.1 percent of the arsenic contained in the particular material handled. Controls applied were estimated to 90 percent efficient in capturing or retarding the generation of emissions. In the case of Godfrey roaster calcine handling, it is assumed that engineering control measures presently being installed at the smelter are in-place. Actual installation of these engineering controls is scheduled for completion by the end of November 1983.

Raw material handling. The emission estimate of 0.7 lb/h for raw material handling was calculated based on data in a detailed arsenic plant material balance supplied to ESED by ASARCO for which confidential treatment has been requested. The operations included in the 0.7 lb/h

estimate are the transfer of flue dusts from the arsenic plant storage silos to a zig-zag blender, the discharge of blended materials to one of three storage bunkers, the transfer of materials from the storage bunkers to a conveyor, the conveying of materials to the Godfrey roaster feed hoppers, and the charging of the roasters from the feed hoppers.

Godfrey calcine loading. Based on ASARCO data, the 1982 annual average hourly arsenic content of Godfrey roaster calcines loaded in rail cars and shipped to East Helena, Montana, for lead recovery is 64 lb/hr (BID, p. 2-24). Applying the material handling emission and control factors previously cited yields an estimated arsenic emission rate of 0.006 lb/h for this operation.

Arsenic trioxide product loading. ASARCO data indicate that the 1982 annual average hourly arsenic content of arsenic trioxide product is 1504 lb/h (BID, p. 2-24). Using the same methodology employed above, the estimated arsenic emission rate for handling arsenic trioxide product is 0.15 lb/hr.

Metallic arsenic production. According to ASARCO data, the 1982 annual average hourly arsenic input to the metallic arsenic plant was 111 lb/h (BID, p. 2-24). Input arsenic is in the form of purchased, refined arsenic trioxide which is manually loaded from barrels into the hoppers of the two metallic arsenic furnaces. The final product is manually removed from the condensers downstream of the furnaces and loaded into barrels for shipment. ASARCO data indicate that the 1982 annual average hourly arsenic output of the metallic arsenic plant was 99 lb/h (BID, p. 2-24). ESED based its estimate of fugitive arsenic emissions from the metallic arsenic plant on an approximate annual average hourly arsenic throughput of 100 lb/h. Employing the same material handling emission and control factors used for other sources in the arsenic plant, we estimated that fugitive arsenic emissions from the metallic arsenic plant amount to 0.1 lb/h.

Arsenic plant baghouse dust transfer. Dust collected in the arsenic plant baghouse is conveyed by air slide to the "top flue," from which it is periodically pulled and transported to the arsenic trioxide product storage bin. Based on ASARCO data, the 1982 annual average hourly arsenic content of the arsenic plant baghouse dust is 807 lb/h (BID, p. 2-24). The estimated fugitive arsenic emission rate for transfer of baghouse dust to the "top flue," 0.08 lb/h, was calculated using the same material handling emission and control factors discussed previously.

Material Handling

Low-level arsenic emissions from material handling at the smelter are the result of dust losses from conveying equipment and material transfer operations. As discussed on pages 2-38 and 2-39 of the BID, the emission factor used to estimate potential emissions from material handling

operations is 0.1 percent of the arsenic contained in the transferred materials. At the ASARCO-Tacoma smelter it is further judged that 90 percent overall control is achieved by means of engineering controls at the smelter and/or the suppressive effect of moisture contained in the materials handled. Combining the 0.1 percent emission factor for potential emissions with the 90 percent control estimate results in an overall emission factor of 0.01 percent of the arsenic contained in the transferred materials. This factor was used in calculating the low-level arsenic emission estimates for the following material handling operations:

Dust transfer from the chemical plant cottrells and brick flues to the fine ore bins. The ASARCO 1982 material balance indicates that the annual average hourly arsenic content of the dusts transferred from the chemical plant cottrells and the No. 1 and No. 2 brick flues to the fine ore bins was 462 lb/h (BID, p. 2-23). Applying the 0.01 percent emission factor yields an estimated arsenic mission rate of 0.05 lb/h.

Godfrey calcines transfer from the arsenic plant to the fine ore bins. The ASARCO 1982 material balance shows that the annual average hourly arsenic transfer rate of Godfrey copper-rich calcines to the fine ore bins was 453 lb/h (BID, p. 2-24). Using the 0.01 percent emission factor, the estimated low-level arsenic emission rate from this operation is 0.04 lb/h.

Concentrate charge from the fine ore bins to the multihearth roasters. The ASARCO 1982 material balance indicates that the annual average hourly arsenic content of the concentrate charge to the multihearth roasters from the fine ore bins was 517 lb/h (BID, p. 2-23). An estimated emission rate of 0.05 lb/h results from application of the 0.01 percent emission factor.

White dust and brick flue dust transfer from the fine ore bins to the arsenic plant. The ASARCO 1982 material balance shows that the annual average hourly arsenic transfer rate in "white" dust and pulled flue dusts from the fine ore bins to the arsenic plant was 385 lb/h (BID, p. 2-24). Applying the 0.01 percent emission factor yields an estimated arsenic emission rate of 0.04 lb/h.

Dust transfer from Cottrells to the arsenic plant. The ASARCO 1982 material balance shows that the annual average hourly arsenic content of the dust transferred from the No. 1 and No. 2 Cottrells to the arsenic plant was 1066 lb/h (BID, p. 2-23). Based on the 0.01 percent emission factor, the estimated arsenic emission rate from this operation is 0.1 lb/h.

Dust transfer from the roaster baghouse to the arsenic plant. The ASARCO material balance shows that the 1982 annual average hourly arsenic content of the dust transferred from the roaster baghouse to the arsenic plant was 561 lb/h (BID, p 2-23). Applying the 0.01 percent

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emission factor yields an estimated arsenic emission rate of 0.06 lb/h for this operation.

Slag Dumping. The estimate for slag dumping was developed using the emission factor previously discussed for slag tapping, i.e. 0.0022 pounds of arsenic is emitted to the air per pound of arsenic present in the slag. For the purpose of deriving an emission estimate for slag dumping, it was assumed that the slag tapping emission factor represents the maximum emission of arsenic during slag dumping. A maximum emission rate was calculated by dividing the 0.0022 emission factor by 15 minutes, the duration of a typical slag tap. This results in a maximum arsenic emission rate for slag dumping of 0.00014 lbs arsenic emitted to the air per pound of arsenic in the slag per minute. Further, it was assumed that after dumping, the emissions decrease linearly with time as the slag cools, reaching zero after 5 minutes. Integration of the resultant curve yields an emission factor for slag dumping of 0.00034 lbs arsenic emitted to the air per lb of arsenic in the slag. The ASARCO 1982 material balance shows that the annual average hourly arsenic content of the slag dumped is 463 lb/h (BID, p. 2-23). Applying the emission factor developed above results in an estimated arsenic emission rate for slag dumping of 0.17 lb/h.

If you have any questions concerning the above estimates or their bases, please contact me at (919) 541-5601.

Sincerely yours,

Alfred E. Vervaert

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Industrial Studies Branch
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